

**TURF EQUIPMENT AND METHOD OF SELECTIVE DEBRIS REMOVAL
FROM TURF**

FIELD OF THE INVENTION

The present invention relates to turf maintenance equipment and more particularly to turf
5 cleaning and grooming equipment and a method of removing debris from turf. Yet more
particularly the present invention relates to a novel artificial turf debris collection machine
suitable for use on artificial turf having loose turf fill material, the machine for selectively
removing debris elements from the artificial turf surface while returning captured turf fill
material to the turf surface.

BACKGROUND OF THE INVENTION

10 Synthetic or "artificial" grass turf has been developed in order to reduce the expenses of
maintaining athletic playing areas, and to increase the durability of the turf surface. Synthetic
turf generally involves a carpet-like pile fabric with a flexible backing laid on a compacted
substrate, such as crushed stone or other stabilized base material. The pile fabric has upstanding
15 synthetic ribbons representing grass blades extending upwardly from the top surface of the
backing. Various formulations for granular resilient fill have been developed, the turf fill
material being placed between the upstanding ribbons on the upper surface of the backing. Some
prior art systems involve the use of sand or crushed slag particles, together with a resilient foam
backing or crumb rubber particles to provide resilience. One such synthetic turf assembly is
20 disclosed in U.S. Patent No. 5,958,527, the entire disclosure of which is incorporated by
reference herein.

Efficient removal of debris, such as dust, food elements, papers, etc. from the surface of
an artificial grass turf surface is desired. The debris may include various sized elements, from
dust and small seeds, etc. to larger drink cups and other litter. A typical vacuum-based sweeper
25 machine, such as disclosed in U.S. Patent No. 5,659,921, is capable of removing debris from the
turf surface. However, such a vacuum sweeper machine would also capture some of the loose
particulate infill material from the synthetic grass turf. Replacement of an equal amount of the
removed infill material would subsequently be required.

Additionally, some debris found on the artificial turf surface may be somewhat buried beneath the surface and otherwise held by fibers of the turf pile. The sweeping brush of a known sweeping machine may have difficulty dislodging buried or held debris for capture. It would be desirable to pre-condition the turf to dislodge debris within the turf allowing the sweeping brush to engage and throw the debris from the turf surface toward a debris hopper.

Furthermore, the appearance of synthetic turf surfaces may be changed, in a manner similar to carpet surfaces, by altering the nap or directionality of the turf pile. It would be desirable to provide a uniform directionality to swaths of the turf surface as the maintenance machine traverses the surface. An efficient method of grooming the turf pile nap would thus be desired.

SUMMARY OF THE PRESENT INVENTION

The present invention teaches, enables and discloses an artificial turf surface maintenance machine and a method of removing debris from an artificial turf surface having turf fill material disposed therewithin. Such a machine may be a self-powered machine capable of transport across the turf surface. Elements of a turf surface maintenance machine according to the present invention include a sweeping brush for engaging debris upon the turf surface and for conveying the debris and some of the turf fill material toward a hopper, and a coarse hopper filter for capturing the debris while permitting the collected loose turf fill material to pass and be deposited back onto the turf surface.

A further aspect of the improved turf machine provides a turf surface preconditioning device for engaging the turf and loosening debris from the turf. The turf surface preconditioning device may be a transverse turf engaging element disposed upon the front of the turf machine. The turf surface preconditioning device may be selectively controlled to vary the amount of engagement of the element with the turf.

Yet another aspect of the improved turf machine includes a turf surface grooming device for engaging the turf and biasing the turf pile into a predetermined groomed orientation. The turf surface grooming device may include one or more rear mounted brush elements which engage the turf.

These and other objects, features and advantages will become apparent in light of the following detailed description of the preferred embodiments in connection with the drawings. Those skilled in the relevant art will readily appreciate that these drawings and embodiments are merely illustrative and not intended to limit the true spirit and scope of the invention disclosed, taught and enabled herein.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention will be described in detail hereinafter with reference to the accompanying drawings, in which like reference numerals refer to like elements throughout.

FIG. 1 is an elevational side view of an exemplary self-propelled surface maintenance vehicle employing an embodiment of the turf equipment according to the present invention.

FIG. 2 is a perspective view of an exemplary self-propelled surface maintenance machine employing an embodiment of the turf equipment according to the present invention.

FIG. 3 is an elevational side view a portion of the machine of FIG. 2.

FIG. 4 is an exploded perspective assembly drawing of a turf engagement structure according to present invention.

FIG. 5 is an exploded perspective assembly drawing of a debris hopper structure according to present invention.

FIG. 6 is an exploded perspective assembly drawing of a turf grooming structure according to present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

In FIG. 1 a sweeping machine 100 incorporating aspects of the present invention is indicated to have a body indicated generally at 10 and driving wheels 12 and 14. As is conventional in sweeping machines of this type there may be two forward driving wheels and a

single rear wheel, although the invention should not be so limited. There is a rotatable brush 16 which extends transversely across the body of the machine and as illustrated by the arrow 18 will be rotated in a clockwise direction to direct dust and debris forwardly into a debris collection chamber or hopper indicated generally at 20. There is a ramp 22 which defines the entrance to the debris chamber 20, with the debris chamber being forward of the brush 16 as is customary in forward throw sweeping machines. Positioned above and slightly forward of the debris chamber 20 is a dust collection chamber 24 having a filter assembly 26 therein, with the filter assembly 26 having a movable shaker 28 mounted thereon. Further details of the sweeper may be shown in U.S. Pat. Nos. 5,303,448 and 5,659,921, the disclosure of each expressly incorporated by reference herein.

In FIGS. 2 and 3, another embodiment of a walk-behind turf sweeper incorporating aspects of the present invention is indicated. Additional aspects of the sweeper may be shown in U.S. Patent No. 5,884,353, the disclosure expressly incorporated by reference herein. Like element numerals depict similar elements throughout the drawings.

The machine 100 of FIG. 1 shown disposed upon a turf surface 30. Turf surface 30 is an assembly including a plurality of upstanding synthetic fibers or ribbons 32 representing grass blades, and a turf fill material 34 of particulate matter disposed interstitially between the upstanding ribbons 32. The turf fill material 34 may include sand and rubber particles or granules. The infill material 34 serves to provide a degree of cushion or resiliency to the turf surface 30. Debris of the turf surface 30 is generally indicated as numeral 36, though the debris 36 may include elements of various size, shape, texture, and material. Turf surface 30 may also include a natural turf surface of grass having a sand-based or other turf fill material.

Above and to the rear of the dust collection chamber 24 is a vacuum fan indicated diagrammatically at 42, with the vacuum fan creating an air flow path indicated by the series of arrows designated at 44. The air flow includes entrained debris 36 and turf fill material 34. The air flow path begins directly adjacent the forward throwing sweeping brush 16, passes through the debris chamber 20, then through a series of baffles 46 into the dust collection chamber 24. The air flow path then passes through the filter 26 and exhausts from the vacuum fan as indicated

by the arrow 48. The described dust collection path is conventional in sweeping machines of this type.

Disposed within the debris chamber 20 are filters 50, 52 for capturing debris 36 from the air stream while permitting air-entrained turf fill material 34 to pass through and be directed back toward the surface of the turf 30. As illustrated in FIG. 5, the filters 50, 52 may be secured within the hopper body 20. The filters 50, 52 may include a plurality of screens having different apertures for capturing different sized debris. In the illustrated embodiment of FIGS. 1 through 6, the filters 50, 52 include an upper filter 50 and a lower filter 52 each of which are in generally horizontal and parallel alignment relative to the turf surface 30. Alternative orientations of filters 50, 52 may also be practicable. A filter shaker (not illustrated) may also be utilized to facilitate the entrained material filter process. The filters 50, 52 may include wire screen elements, perforated metal plates, or expanded metal screen materials. Alternative filtering devices may also be utilized provided that the devices permit the passage of the turf fill material 34 while capturing debris 36 from the turf surface 30. In the illustrated embodiment of FIGS. 1 through 6, a wire screen having a mesh size of 5 x .047 inch has found particular utility for the lower filter 52. The upper filter 50 includes a slightly larger aperture size compared to the lower filter 52 to capture larger debris elements 36 and prevent the smaller apertures of the lower filter 52 from becoming clogged with debris 36.

Referring to FIGS. 1 and 4, the machine 100 further includes a turf engaging structure 60 disposed forwardly from the sweeping brush 16 for preconditioning the turf. The structure 60 engages the turf and facilitates loosening of debris 36 from the turf. During turf engagement by the structure 60, some debris 36 may be ejected from the turf surface 30 and directed rearwardly toward the brush 16. Other debris may be lifted or loosened from the turf surface 30 by the turf engaging structure 60 and be subsequently removed from the turf by the brush 16. The turf engaging structure 60 includes a generally planar turf engaging element 62 which may be selectively adjusted to vary the contact between the element 62 and the turf 30. As illustrated in FIG. 4, the turf engaging structure 60 includes a pair of frame elements 64 rigidly coupled to the machine 100, a movable carriage 66 disposed between the frame elements 64, and a turf engaging element 62 coupled to the movable carriage 66. The movable carriage 66 is pivotable with respect to the machine 100 along pivot axis 70. The movable carriage 66 may be

selectively positioned relative to the machine 100 by selectively coupling the movable carriage 66 to the frame elements 64 via one of a series of alignment apertures 72 of the movable carriage 66. The turf engaging plate element 62 is coupled to the movable carriage 66 by threaded fasteners and a plate retainer 74. A bumper 76 is further provided upon the turf engaging structure 60. The turf engaging element 62, illustrated as a single planar element, may assume alternative configurations, including but not limited to multiple plate elements in both transverse and longitudinal application, diverse edge configurations, and different materials including static electricity reducing compositions.

Referring now to FIGS. 1 and 6, an improved turf machine 100 includes a turf surface grooming device 80 for engaging the turf and biasing the turf pile into a predetermined groomed orientation (into the direction of machine travel). The turf surface grooming device 80 may include one or more brush elements, which may be powered or stationary brushes (relative to the machine 100). The turf surface grooming device 80 may also include a towed structure, including mesh or screen elements (not shown), for biasing the turf pile. In a preferred embodiment, the turf surface grooming device 80 is a stationary brush structure movably coupled to the rear of the machine 100. The turf surface grooming device 80 may include a plurality of rear mounted brush elements 82 which engage the turf pile and provide a directional nap to the engaged turf swath. The brush elements 82 are movably coupled to the machine 100 via an attachment structure 84. The attachment structure 84 may be controlled via linkages 86 to vary the amount of down force transferred to the brush elements 82. Alternative attachment structures 84 would be appreciated by those skilled in the relevant arts.

In operation, the machine 100 traverses the debris littered turf surface 30 under control of an operator. During movement of the machine, the turf surface 30 is initially engaged by the turf engaging device 60, which preconditions the turf surface 30 by lifting and/or loosening debris 36 upon the turf. The degree of turf engagement may be varied (depending on the turf type, debris type, or other conditions) by manipulating the relative position of the turf engaging element 62 relative to the machine 100. The turf surface 30 is next engaged by sweeping brush 16 which contacts and throws the debris 36 and some turf fill material 34 forwardly and upwardly into the hopper 20. The sweeping brush 16 preferably engages only the top portion of the turf surface 30, i.e., a relatively light sweep is required to contact and throw debris from the turf. The mixture of debris 36 and turf fill material 34 is processed by the filters 50, 52, which capture larger elements

of debris 36 while permitting the passage of the turf fill material 34 back onto the turf surface 30, shown generally as numeral 90. The turf surface 30 is finally engaged by the grooming device brushes 82 which bias some substantial portion of the turf pile into the direction of movement, the groomed turf shown generally as numeral 92. The result of the grooming device 82 is to improve the aesthetic of the turf surface 30, e.g. to provide a "just mowed" look to the turf surface 30.

Additional advantages and modifications will readily occur to those skilled in the art upon reflection on the teaching, written disclosure and illustrations herein. The invention in its broader aspects is, therefore, not limited to the specific details, representative apparatus and illustrative examples shown and described. Accordingly, departures from such details may be made without departing from the spirit or scope of the applicant's general inventive concept.

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